

ANNUAL REPORT

1962

CITY OF KITCHENER

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KITCHENER

WATER POLLUTION CONTROL PLANT

OWRC PROJECT NO. - 58-S-19

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KITCHENER WATER POLLUTION CONTROL PLANT

OWRC PROJECT NO. - 58-S-19

OPERATED FOR

THE CITY OF KITCHENER

BY

THE ONTARIO WATER RESOURCES COMMISSION

Mr. A. M. Snider

Chairman

Dr. A. E. Berry

General Manager

Mr. D. S. Caverly

Asst. General Manager,

and Director of Plant Operations

Mr. B. C. Palmer

Assistant Director,

Division of Plant Operations

Mr. D. A. McTavish

Project Engineer,

Division of Plant Operations

Prepared by the

Division of Plant Operations

KITCHENER WATER POLLUTION CONTROL PLANT

GENERAL

The Kitchener Doon Water Pollution Control Plant was renovated and enlarged in 1959. It is a primary treatment plant with sludge digestion and has an 11.5 million gallons per day capacity. During the same year, the overloaded Spring Valley activated sludge plant was replaced by a pumping station. The Spring Valley pumping station pumps sewage to a high point in the Kitchener sewer system and sewage flows by gravity from there to the Doon plant.

DESIGN DATA

The plant was designed by Proctor and Redfern, Consulting Engineers. Construction of the renovation was carried out by the prime contractor, Dunker Construction Limited.

(1) Inlet Works

The sewage reaches the plant via a 48 inch diameter trunk main. Large solids are removed by a coarse bar screen. The sewage then passes through a 3 foot Parshall flume where the flow is measured, indicated and recorded. Rotogrators, which are mechanically cleaned screens equipped with grinders, receive the sewage from the Parshall flume.

(2) Screen and Grit Building

Flow from the inlet works is evenly divided between two aerated grit chambers. The sand and grit are removed in these chambers and air lifted to a hopper. The sand and grit is then hauled away and buried.

Both air degritters are 16' x 10' x 12' SWD and have a total volume of 23,000 gallons. This provides a retention of three minutes at design flow.

Two fine mesh rotary screens receive sewage from the grit removal units. The screens remove small particles which pass through the rotogrators and which do not settle in the aerated grit chambers.

(3) Primary Clarifiers

A grease separator is located on each side of the grit building and sewage passes through these units prior to entering the primary clarifiers. Large quantities of air are bubbled into the sewage as it passes through the separator. The grease separates from the sewage and rises to the surface in the form of grease balls. These grease balls form on the surface of the primary clarifiers and are removed manually.

Four primary clarifiers are provided. Three of the above clarifiers were built previously and the other unit was added in 1959. Each of the tanks are 60' x 60' x 11.75' SWD and provide a retention of 2.2 hours at design flow. They were designed for a surface loading of 820 gallons per square foot per day and the older units have a weir loading of 58,000 gallons per foot per day while the new unit has a weir loading of 13,400 gallons per foot per day.

(4) Digesters

Two primary and two secondary digesters were provided. The secondary digesters were constructed in 1959.

Raw sludge from No. 1 and No. 2 primary clarifiers flows by gravity to the primary digesters. Sludge from the other clarifiers is pumped to the digestion tanks.

Each of the primary digesters is 65' in diameter with a 22' SWD and having a combined volume of 900,000 gallons. Both of these tanks have fixed concrete roofs supported by structural steel bridges. Each one is equipped with a new draft tube mixer and is provided with level controls which automatically record the level of the liquid in the tanks.

Heating of the primary digesters is accomplished with two Rayscott hot water boilers and two spiral heat exchangers. The boilers are equipped to burn fuel oil or digester gas. Water temperature in the spiral heat exchangers is held at the proper level by the thermostat settings on the boiler. The temperature in both digesters is maintained by controlling the amount of circulation through the heat exchangers.

The two new secondary digesters are equipped with floating steel covers and are not heated. Each tank is 100 feet in diameter with a 29 ft. SWD. The total volume of both tanks is $2\frac{1}{2}$ million gallons. Gas collection equipment is provided with the secondary digesters.

(5) Vacuum Filtration

Sludge from the secondary digesters is pumped to the vacuum filter building. Ferric chloride (or pickle liquor) and lime are mixed with the sludge and the mixture is fed to the vacuum filter. The vacuum filter is a Komline-Sanderson stainless steel

spring filter with 500 square feet of surface.

The sludge from the filter is placed in trucks and spread on farmland..

(6) Spring Valley Pumping Station

This station is equipped with two 2,500 gpm pumps each driven by an 100 HP electric motor. In the case of power failure, a 3,750 gpm pump driven by a diesel engine starts automatically. A 20 inch force main carries the sewage to a higher location in the municipal sewer system and from there it flows by gravity to the Doon Water Pollution Control Plant. A bypass to the Grand River is provided.

The station is automatic and in addition can be remotely controlled from the Doon plant.

OPERATING RESULTS

(1) Loadings and Removals

Table I and the graph of average daily flows indicate the flows experienced at the plant during the year. The absolute maximum flow for one day occurred in March and was 14.10 million gallons. This is greater than the design flow of 11.5 million gallons. The minimum daily flow also occurred in March and was 4.08 million gallons.

The average daily flow for the year was 8.95 million gallons and the total flow was 3,254.55 million gallons. The total flow during 1961 was 2,649.6 MG. The 1962 flow represents a 23 percent increase over the 1961 flow.

The graph relating to flow shows that the design hydraulic capacity of the plant was exceeded 5 percent of the time.

Data relating to grit, BOD and suspended solids removal is shown on Table II. The BOD and SS data is also shown in the two graphs included in the report.

The concentration of BOD in the raw sewage averaged 306 ppm compared with 297 ppm in 1961 and the SS concentration averaged 289 ppm compared with 278 in 1961.

The graphs indicate that 10 percent of the SS samples and 7 percent of the BOD samples exceeded concentrations of 400 ppm.

The above indicates a sewage with higher than average concentrations of BOD and SS. It is also evident that the 1962 sewage strengths have changed only slightly from the concentrations experienced in 1961.

The average reduction in BOD and SS through the plant was 33% and 45% respectively. This is slightly below the average efficiency for similar plants with strong raw sewage.

The average amount of grit removed from the sewage was 1.6 cubic feet per million gallons of sewage. This figure compares well with similar municipalities.

(2) Digestion

The amount of raw sludge pumped to the digesters is shown on Table III. Solids determinations on the raw sludge from all four primary clarifiers indicate that concentration of the solids is slightly better in the new clarifier. Close laboratory control during the latter portion of the year resulted in sludge of a higher concentration being pumped to the digesters. The higher

concentration resulted in less volume to the digesters and therefore decreased the loading on them.

A total of 2,921 tons of raw sludge was pumped to the digesters. Table IV indicates that 1,338 tons (2,675,954 lbs) of digested sludge were filtered. Therefore, there was a 54 percent reduction in the volume of sludge due to digestion and concentrating in the digesters.

(3) Vacuum Filtration

Table IV indicates the operating results obtained during the year. The average yield for the year (6.9 lbs/sq.ft./hr.) was approximately the same as that encountered in 1961 and is comparable with yields for similar sludge.

The Water Pollution Control Federation Manual of Practice #8 indicates that 1.5 to 3.5 percent of ferric chloride and 6 to 10 percent of lime are required for filtration of digested primary sludge. At Kitchener 3.0 percent of pickle liquor (pickle liquor was used in place of ferric chloride) and 6.1 percent of lime was required.

The cost of vacuum filtering is shown in Table V. The overall cost including chemicals, labour, power and maintenance was \$7.26 per dry ton of filtered sludge. This cost is favourable and is low due to the use of pickle liquor as well as ferric chloride. Pickle liquor is a waste product from the steel industry and is obtainable for the cost of haulage.

OPERATIONS

The plant was under 24 hour supervision during 1962. Personnel at the plant consisted of a superintendent (Mr. A. Becker), a plant mechanic (Mr. W. Reinhart), a plant electrician (Mr. L. Edwards), a laboratory technician (Mr. K. Sakamoto), ten operators (Messrs. L. Lebegut, F. Dobson, Z. Etmansky, P. Kuehl, E. Wheeler, H. Bowie, W. Pohl, J. O'Reilly, J. Halley and A. Schlueter and a groundskeeper, (Mr. A. Neilson). The above staff also supervised the operation of the Spring Valley pumping station.

Assistance was supplied by the head office mechanical maintenance staff in the repair and maintenance of mechanical equipment at the plant. A total of 65 man hours were supplied by the above group in inspection and an additional 46 man hours were spent in supervision and repair.

The removal of sludge from the plant was accomplished through the use of two trucks owned by the City of Kitchener. The city also assisted the operation of the plant through the services supplied by the city garage..

Difficulty in obtaining Domite impellers for the Spring Valley pumping station was experienced during the year. The pump suppliers were unable to obtain this type of impeller and it was decided that stainless steel impellers were required.

While one of the pumps was at the supplier's plant receiving some of the changes agreed to, the shaft of the remaining pump broke. The diesel engine was then placed in service. On May 3rd, the diesel engine exploded damaging the building as well as the engine. The City of Kitchener had had the engine insured

and thus the damage was covered by insurance. A new diesel engine was installed.

The extension to the treatment plant was commenced during the year. Treatment was continued during the construction period. This made operation rather difficult as some of the old treatment units required renovation. It was, however, possible to improvise during this period and all phases of treatment including digestion were maintained.

OPERATING COST

A breakdown of the operating costs incurred during 1962 are shown in Table VI. The total cost for the year was \$100,006.93 compared with an estimate of \$117,100.

The table below illustrates the unit cost of treatment.

<u>YEAR</u>	<u>TOTAL COST</u>	<u>MG TREATED</u>	<u>COST PER 1,000 GAL</u>	<u>COST PER LB. BOD REMOVED</u>	<u>COST PER CAPITA PER YEAR</u>
1961	*118,269.08	2649.6	4.5 ¢	3.9 ¢	\$ 1.64
1962	100,006.93	3254.55	3.1 ¢	2.9 ¢	1.40

* The 1961 expenses were higher than normal due to the payment of a three year insurance premium, fuel costs while a digester was being repaired and the purchase of a sludge transfer pump.

The costs of vacuum filtering are shown on Table V. The average cost per ton of dry solids filtered was \$7.26 during 1962 and \$7.21 during 1961.

TABLE I

FLOW RECORDS M.G.D.

POPULATION - 74,522

MONTH	ABSOLUTE MAXIMUM	ABSOLUTE MINIMUM	MAXIMUM 24 HOUR FLOW	AVERAGE 24 HOUR FLOW	MINIMUM 24 HOUR FLOW	TOTAL MONTHLY FLOW MG.	PLANT BYPASS (HOURS)	AVERAGE FLOW (GALS) PER CAPITA PER DAY
JANUARY	12.2	2.2	10.22	7.83	4.48	242.81	NIL	1050
FEBRUARY	16.0	3.2	12.46	9.41	6.60	263.57	NIL	1260
MARCH	16.0	4.0	14.10	10.24	4.08	317.34	NIL	1380
APRIL	16.0	5.0	12.05	9.94	6.82	298.07	NIL	1330
MAY	15.6	4.0	10.65	8.30	5.46	257.17	3½	1110
JUNE	19.5	3.8	11.15	8.97	5.55	269.20	4	1205
JULY	14.2	3.4	9.98	7.96	5.51	246.70	NIL	1070
AUGUST	17.0	3.4	10.18	8.32	5.41	249.71	NIL	1120
SEPTEMBER	16.4	3.2	10.06	8.26	5.43	247.73	NIL	1110
OCTOBER	17.0	4.2	11.30	8.80	5.41	272.90	NIL	1180
NOVEMBER	17.0	4.2	12.74	9.92	6.40	297.66	NIL	1330
DECEMBER	15.8	4.8	12.93	9.41	6.58	291.69	NIL	1265
TOTAL	192.7	45.4	137.82	107.36	67.73	3254.55	7½	14410
AVERAGE PER MONTH	16.0	3.8	11.49	8.95	5.64	271.21	0.6	1201

TABLE II
GRIT, BOD AND S.S. REMOVAL

MONTH	B.O.D.				S.S.				GRIT REMOVAL	
	INFLUENT PPM	EFFLUENT PPM	PERCENT REDUCTION	TONS REMOVED	INFLUENT PPM	EFFLUENT PPM	PERCENT REDUCTION	TONS REMOVED	CUBIC FEET	PER M.G. SEWAGE
JANUARY	329	201	39	156	364	164	55	243	635	2.6
FEBRUARY	320	224	30	127	363	210	42	202	398	1.5
MARCH	266	203	24	100	232	165	29	106	364	1.2
APRIL	217	186	14	46	236	163	31	109	304	1.0
MAY	258	170	33	113	280	152	46	165	335	1.3
JUNE	250	171	32	106	182	131	28	69	587	2.2
JULY	296	168	43	158	219	94	57	154	459	1.9
AUGUST	262	187	29	94	295	166	44	161	479	1.9
SEPTEMBER	336	216	36	148	282	172	39	136	439	1.8
OCTOBER	384	228	41	213	321	141	56	246	452	1.7
NOVEMBER	484	221	54	392	375	143	62	345	412	1.4
DECEMBER	267	206	23	89	315	157	50	230	277	1.0
TOTAL	3669	2381	398	1742	3462	1858	539	2166	5141	19.5
AVERAGE	306	198	33	145	289	155	45	181	428	1.6

TABLE III
DIGESTER OPERATION

MONTH	% SOLIDS RAW SLUDGE				GALLONS RAW SLUDGE TO DIGESTERS				TONS OF RAW SLUDGE TO DIGESTER	GALS. OF PRIMARY DIGESTED SLUDGE TO DIGESTERS	
	CLARIFIER #1	CLARIFIER #2	CLARIFIER #3	CLARIFIER #4	#1	#2	#3	#4		#3	#4
JANUARY	2.9	3.1	2.8	4.8	648,000	648,000			220	324,000	324,000
FEBRUARY	2.1	2.4	2.5	3.0	525,969	525,969			132	275,216	275,216
MARCH	2.4	2.5	3.3	3.3	658,800	664,800			192	334,800	334,800
APRIL	4.5	4.1	3.5	5.3	633,600	633,600			279	349,200	349,200
MAY	3.9	3.6	4.7	3.8	614,100	614,100			245	614,100	614,100
JUNE	5.1	4.9	5.2	5.7	493,000	493,000			257	513,000	393,000
JULY	5.5	5.4	5.0	5.1	406,200	406,200			215	289,000	517,400
AUGUST	5.5	6.0	5.1	4.6	411,400	415,600			220	428,200	376,200
SEPTEMBER	4.6	4.8	4.7	5.1	96,250	96,250	271,950	271,950	177	100,800	NIL
OCTOBER	4.8	4.6	4.6	4.7	52,800	52,800	343,200	343,200	186	NIL	NIL
NOVEMBER	6.4	6.1	6.5	7.2	411,600	220,600	140,400	152,400	306	NIL	NIL
DECEMBER	7.4	7.9	7.7	7.2	610,200	687,000			492	560,600	560,600
TOTAL	55.1	55.4	55.6	59.8	5561,919	5,457,919	755,550	767,550	2,921	3,788,916	3,744,516
AVERAGE PER MONTH	4.6	4.6	4.6	5.0	463,493	454,827	62,962	63,963	243	315,743	312,043

SAMPLE CALCULATION FOR TONS OF RAW SLUDGE TO THE DIGESTER

$$\frac{(2.9 + 3.1 + 2.8 + 4.8)}{(4)} \frac{(10^4)}{(2000)} (0.648 + 0.648) (10) = 220 \text{ TONS}$$

TABLE IV
COIL FILTER OPERATING DATA

MONTH	HOURS OF OPERATION	SLUDGE		CHEMICALS VS. DRY WEIGHT SOLIDS				FILTER CAKE	
				POUNDS USED		PERCENT USED		PERCENT MOISTURE	YIELD LBS PER SQUARE FT. PER HOUR
		% SOLIDS DRY WEIGHT	LBS DRY SOLIDS FILTERED	CAO	FeCl ₃	CAO	FeCl ₃		
JANUARY	106	12.8	353,612	21,648	8141	6.0	2.3	71.9	6.8
FEBRUARY	38	12.1	109,095	9,044	3738	8.4	3.5	71.3	5.7
MARCH	84	12.7	235,250	17,080	8102	7.2	3.2	70.9	5.6
APRIL	124	12.1	400,197	23,212	11379	5.8	2.8	72.2	6.2
MAY	54	12.1	165,100	10,934	4995	6.6	3.1	73.4	6.1
JUNE	77	11.2	283,700	17,220	8152	6.1	2.2	72.8	7.4
JULY	53	10.8	181,800	10,325	5016	5.7	2.8	73.6	6.9
AUGUST	80	11.2	310,300	15,925	7650	5.1	2.5	72.4	7.8
SEPTEMBER	26	12.1	112,800	5,075	2553	4.5	2.3	70.0	8.8
OCTOBER	68	13.8	278,700	14,175	9840	5.1	3.5	68.6	8.3
NOVEMBER	55	9.4	186,700	11,110	6300	6.0	3.4	72.3	6.8
DECEMBER	20	8.9	58,700	4,025	2475	6.9	4.2	73.3	5.9
TOTAL	785	139.2	2,675,954	159,773	78341	73.4	35.8	862.7	82.3
AVERAGE	65	11.6	222,996	13,314	6528	6.1	3.0	71.8	6.9

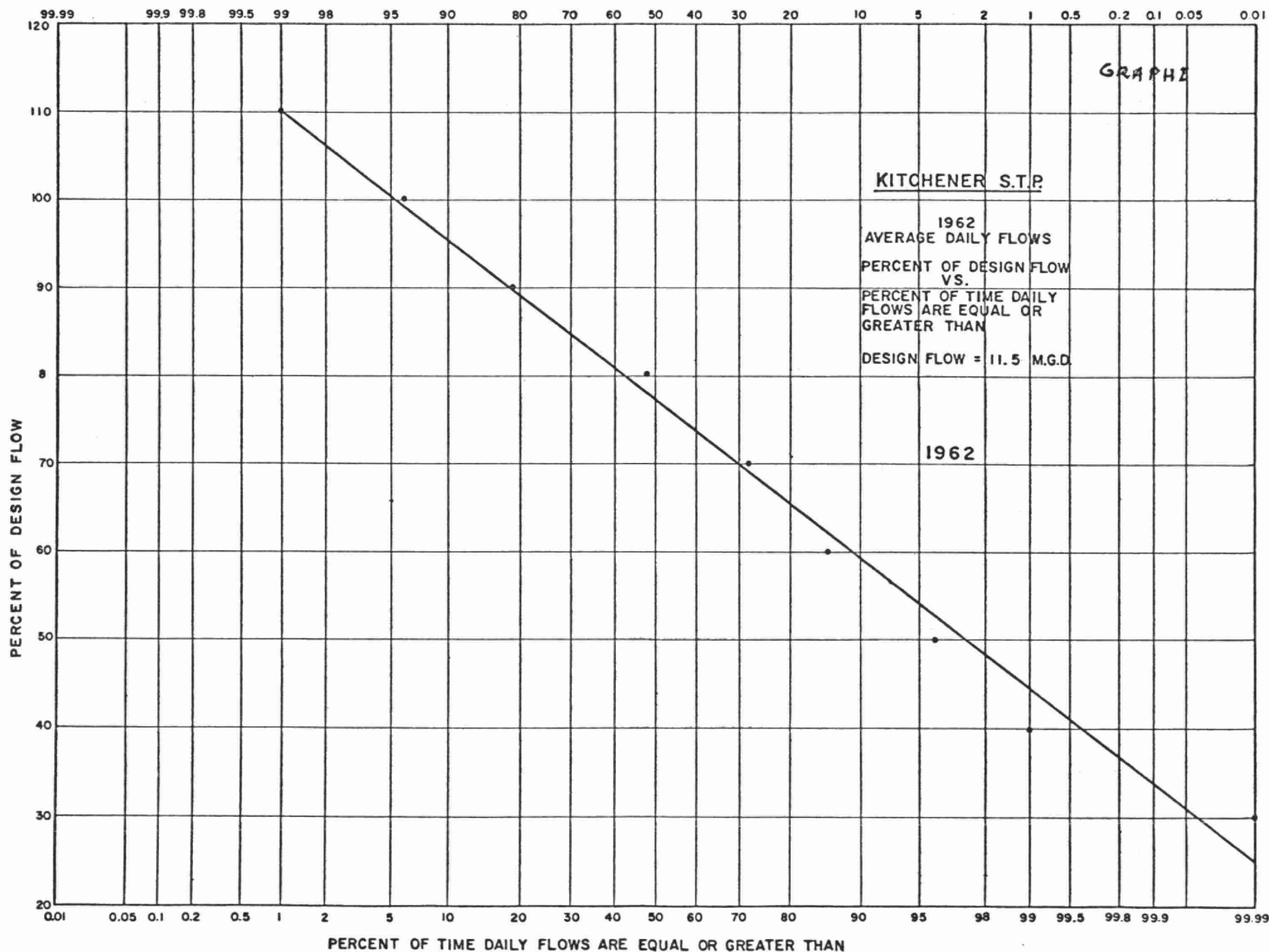
TABLE V
COIL FILTER DEWATERING COSTS

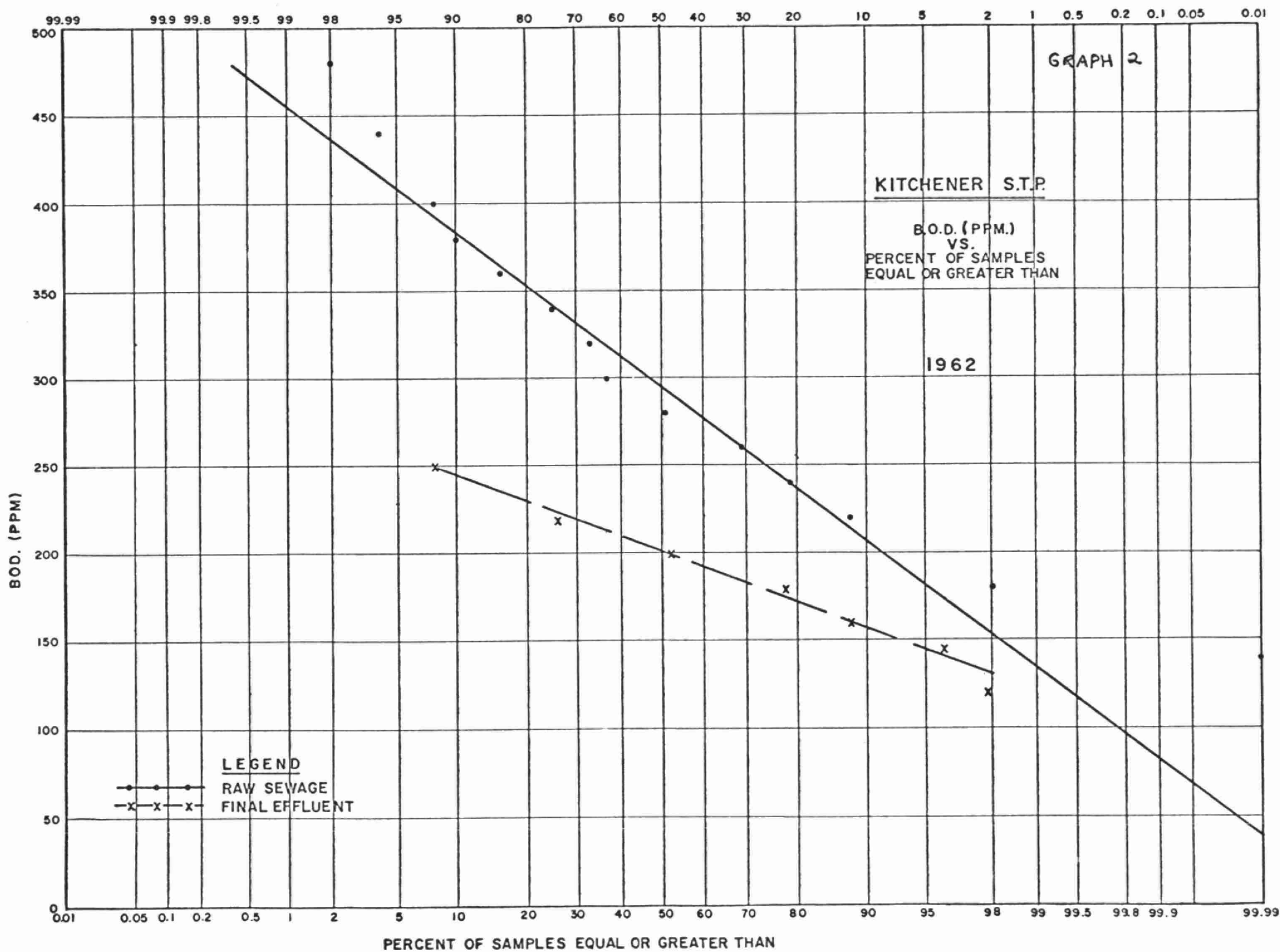
MONTH	COST PER MONTH					ACCUMU- LATIVE TOTAL	COST PER TON DRY WEIGHT					ACCUMU- LATIVE TOTAL
	FeCl ₃	LIME	LABOUR	ELEC.	MAINT.		FeCl ₃	LIME	LABOUR	ELEC.	MAINT.	
JANUARY	116	340	424	247	65	1192	0.66	1.93	2.41	1.40	0.37	6.77
FEBRUARY	53	142	150	77	65	1679	0.98	2.62	2.75	1.40	1.20	15.72
MARCH	116	268	335	164	65	2627	0.98	2.28	2.85	1.40	0.55	23.78
APRIL	172	365	495	280	65	4004	0.96	1.83	2.48	1.40	0.32	30.67
MAY	73	171	215	116	65	4644	0.89	2.07	2.61	1.40	0.79	38.43
JUNE	117	155	306	199	65	5486	0.83	1.09	2.16	1.40	0.46	44.37
JULY	73	163	211	127	65	6125	0.81	1.79	2.33	1.40	0.72	51.42
AUGUST	111	251	320	217	65	7089	0.72	1.62	2.06	1.40	0.42	57.64
SEPTEMBER	37	80	103	79	65	7453	0.66	1.42	1.83	1.40	1.15	64.10
OCTOBER	143	172	270	195	65	8298	1.03	1.23	1.93	1.40	0.47	70.16
NOVEMBER	91	175	219	131	65	8979	0.98	1.88	2.35	1.40	0.70	77.47
DECEMBER	36	63	80	41	65	9264	1.23	2.14	2.72	1.40	2.21	87.17
TOTAL	1138	2345	3128	1873	780	9264	10.63	21.90	28.48	16.80	9.36	87.17
AVERAGE PER MONTH	95	195	261	156	65	772	0.89	1.83	2.37	1.40	0.78	7.26

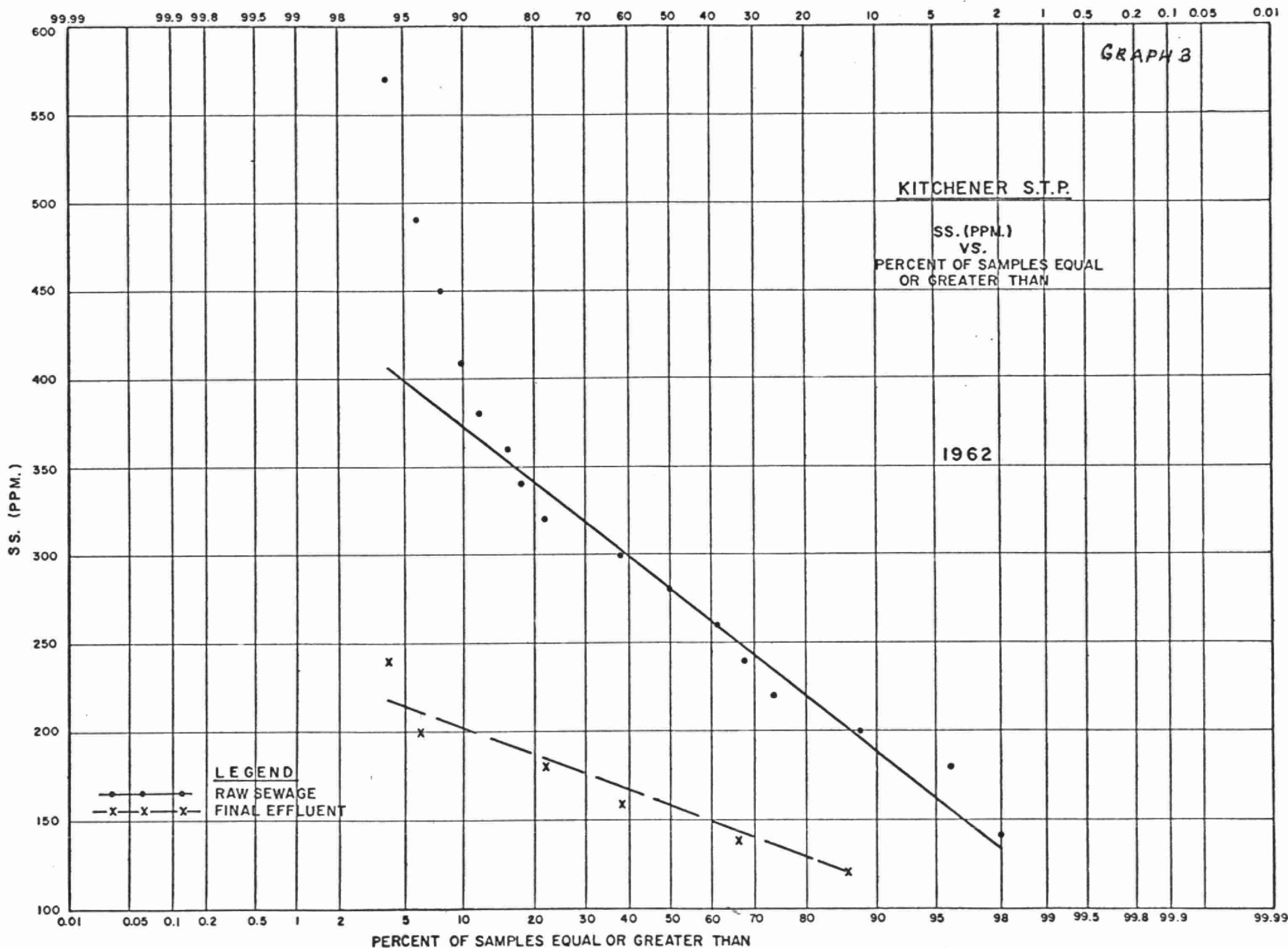
NOTE: LABOUR, ELECTRICITY AND MAINTENANCE ARE FOR FILTER OPERATION ONLY.

TABLE VI
PROJECT OPERATION STATEMENT

MONTH	EXPENDITURE	PAYROLL	CASUAL PAYROLL	FUEL	POWER	CHEMICAL	GENERAL SUPPLIES	EQUIPMENT	REPAIR & MAINT.	WATER	SUNDRY	ACTUAL ACCUM. EXPEND.	BUDGET
JANUARY	6236.85	4642.52		16.16	1028.29	417.40	73.03				59.45	6237	9758
FEBRUARY	7431.41	4642.52		34.11	1076.58	1264.02	161.58		26.40		226.20	13668	19516
MARCH	6039.93	4678.20		91.36	766.53	39.60	149.26				314.98	19708	29275
APRIL	7040.86	4876.81		31.89	1306.08	465.40	92.73	26.88			241.07	26749	39033
MAY	7401.23	4954.72		289.44	78.30	1493.08	344.89	79.87	51.07	46.94	62.92	34150	48791
JUNE	8009.40	4954.72		44.24	1589.80	319.25	240.67	355.06	143.16		362.50	42159	58550
JULY	7254.38	4954.72	254.08	65.06	993.51	368.25	196.88	55.62	79.18		287.08	49414	68308
AUGUST	10145.97	7399.75	357.84	107.06	930.42		662.98	562.71			125.21	59560	78066
SEPTEMBER	10920.85	4954.72	270.74	26.88	964.93	218.50	59.21		50.00	65.97	4309.90	70481	87825
OCTOBER	8396.76	4963.37	13.40	47.40	911.18	1368.20	202.24	308.21	324.90		257.86	78878	97583
NOVEMBER	8924.70	5031.96		57.11	903.54	1805.55	138.98		408.30		579.26	87802	107342
DECEMBER	12204.59	7950.34		60.29	11933.68	48.00	238.31		120.47	35.81	2827.69	100007	117100
TOTAL	100,006.93	64004.35	896.06	871.00	11482.84	7807.25	2550.76	1361.47	1230.36	148.72	9654.12		
AVERAGE	8,350.00	5330.00	75.00	73.00	960.00	650.00	212.00	114.00	103.00	125.00	805.00		







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